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Alberta
ENERGY

Alberta's Energy and Mineral Resources

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Table of Contents

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Page
Introduction 1
Principles of Resource Management 3
The Resources:
  Conventional Crude Oil 5
  Heavy Oil 6
  Oil Sands 7
  Natural Gas 9
  Coal 11
  Minerals 12
Alberta's Energy Milestones 14
Glossary of Terms 15
Appendix 16

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Introduction

Alberta is richly endowed with oil, gas, coal and other mineral resources. The Alberta "basin" is part of the large Western Canadian Sedimentary Basin where thick beds of ancient rock contain abundant deposits of oil, natural gas and coal. Long known as the energy storehouse of Canada, Alberta produces most of Canada's conventional oil and natural gas, fueling everything from automobiles to jets, supplying industry with essential raw materials, and providing heating and plastic products to consumers, business and industry. Massive oil sands, underlying an area larger than the province of New Brunswick, contain one of the world's largest known reserves of recoverable oil and will be increasingly important in Canada's energy future.

Coal and natural gas were being produced even before Alberta became a province in 1905, but significant oil and gas development did not occur until a major discovery of oil at Leduc in 1947. Since then, the oil and gas industry has been vital in diversifying and developing the province's economy. In 1986, it directly generated about 16 per cent of Alberta's gross domestic product. More than 600 head offices of energy and resource corporations are based in Calgary.

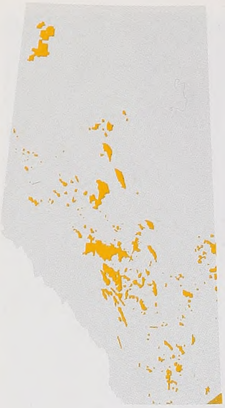
Alberta oil occurs naturally in three forms — conventional crude oil, heavy oil and oil sands. Conventional crude oil, the best known form, refers to oil recovered through normal drilling methods. Heavy oil is more dense than conventional crude, and generally cannot be recovered using conventional methods. Oil sands consist of a black, tar-like mixture of sand, clay, water and bitumen, a naturally occurring mixture of hydrocarbons which in its natural state is not recoverable by conventional means.

As Canada's largest producer of natural gas, Alberta accounted for 89 per cent of the country's total production in 1987. The province's natural gas and oil wealth forms the basis for Western Canada's leading petrochemical industry.

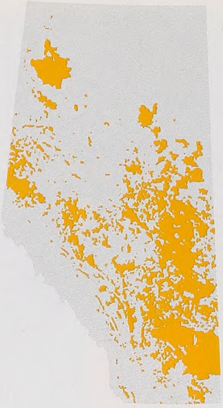
Thousands of industrial and consumer products are produced using oil and gas as raw materials. They include everything from lubricants to plastics, detergents and dyes. The contribution of the petrochemical industry to the manufacturing sector is seen as a key to further diversification of the provincial economy in years to come.

PHOTO: Heavy crude oil

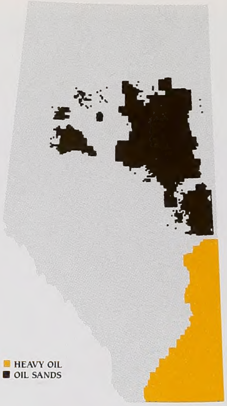
Oil Deposits



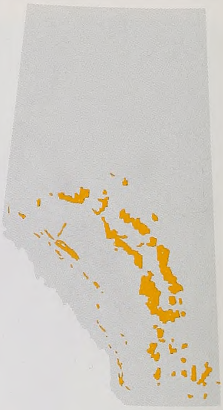
Gas Deposits



Oil Sands & Heavy Oil



Coal Deposits



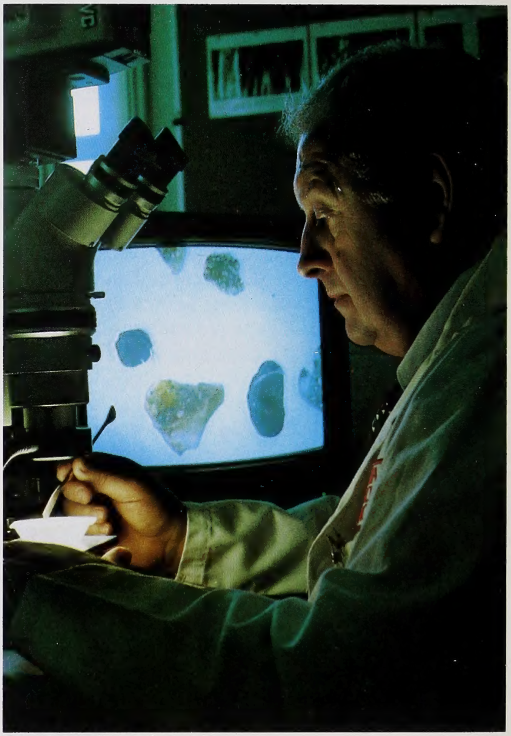
While the province's oil and gas reserves are large, Alberta's coal resources are immense. If used for power only, the province's coal resources would be enough to keep Alberta's existing coal-fired electricity-generating plants supplied for 1,100 years.

Alberta also contains an abundant supply of non-fuel mineral resources. Industrial minerals, such as gypsum and silica sand, are important to the province's construction industry. Metallic minerals including copper, lead, iron ore, uranium, magnesium, titanium and zircon have been found in small quantities.

A well-developed pipeline network ensures delivery of oil and gas resources to markets within Alberta, to the rest of Canada and to the United States. Alberta alone is criss-crossed by more than 180,000 kilometres (112,000 miles) of pipeline. Pumping stations and compressor stations are located at various points along pipelines to move oil and gas to their destinations.

Energy firms operating in Alberta are on the leading edge of research and technology for oil and gas industry operations. They have tamed some of the world's most hostile climates in the high Arctic and offshore. They also offer oilfield services and products to dozens of countries around the world. The search for more economic ways to harness Alberta's oil, gas and other mineral resources continues through major research efforts involving government and industry.

This booklet outlines briefly the history, nature and scope of oil, gas and other mineral resources in Alberta. Further information can be obtained from the sources listed in the appendix. (See page 16.)



Scientist studies coal particles

Principles of Resource Management

In the early part of the 19th century, mineral rights in Canada were granted to the landowner. That changed in 1887, when the federal government passed a bill to reserve mineral rights in the name of the Crown for land sold or granted as homesteads. Ownership and responsibility for mineral resources within the provinces were transferred in 1930 from the federal government to provincial governments.

Today, Alberta owns 81 per cent of the province's mineral resources. The remaining 19 per cent is held by the federal government (in national parks and Indian reserves), and historically by companies descended from private interests such as the Canadian Pacific Railway, the Hudson's Bay Company, and by "freeholders" — descendents of the original homesteaders.

The **Alberta Department of Energy** has the legislated mandate under the Mines and Minerals Act to promote effective management of the province's mineral resources. By right of ownership, it collects the province's fair share of the resource through royalties.

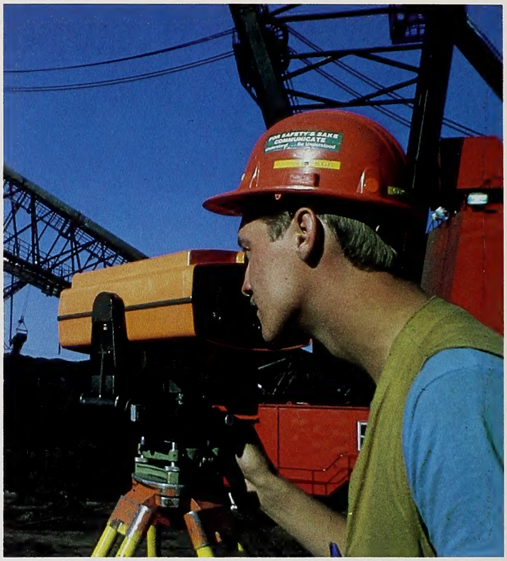
In order to develop Crown minerals, rights to specific locations are leased to companies or individuals. An agreement grants the lessee exclusive rights to explore for and develop minerals in the granted location under specified conditions.

TOP: Alberta coal mine
BOTTOM: Heavy oil well pads

Managing Energy Resources

The **Energy Resources Conservation Board** (ERCB), established in 1938, promotes safe, efficient and environmentally sensitive development of energy resources in the province. All provincial oil and gas resources are protected under the Oil and Gas Conservation Act, which is administered by the ERCB. These resources include coal, hydroelectricity and thermal electricity, natural gas, conventional oil and oil sands, and the necessary pipelines and electricity transmission lines needed to move the resources to distributors. The board receives half its funding from the private sector and half from the Alberta government.

All new energy developments require approval from the ERCB before any construction can begin. The ERCB sets the standards and specifications for the location, equipment and procedures for energy development projects. The board, for example, limits the rate at which oil and gas wells can produce. Public hearings may be held by the ERCB if there are objections to a proposal.

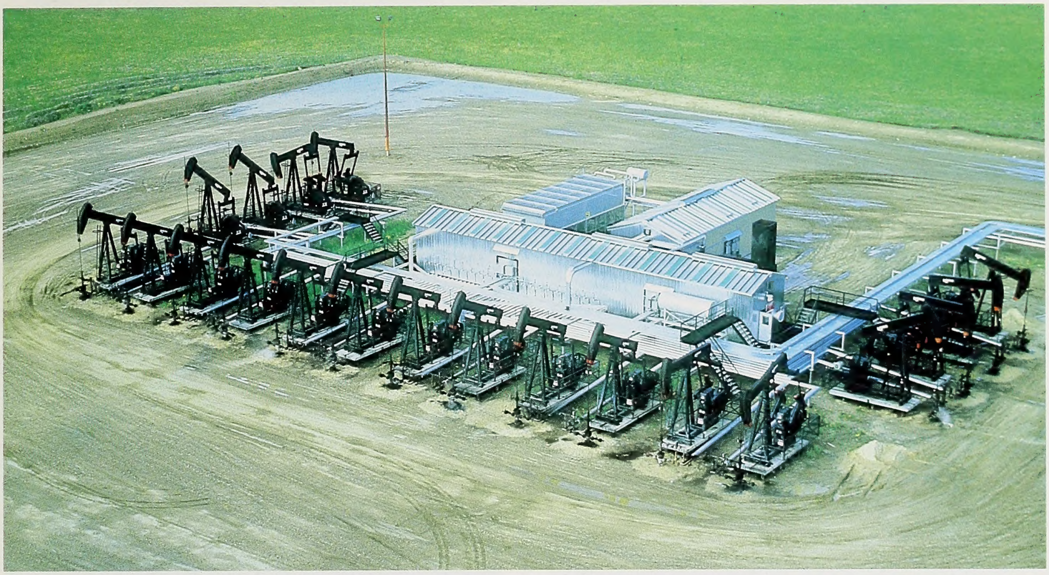


After approval, each project site is inspected to make certain that the operator is meeting the prescribed conditions and standards. Based in Calgary, the ERCB has more than 100 field inspectors, mostly located in field offices throughout the province.

LEFT: Pipeline construction
RIGHT: Surveying the Syncrude oil sands

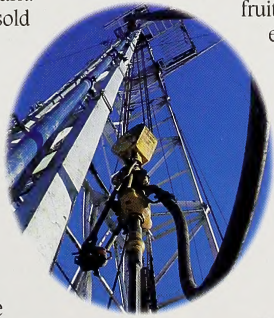
Page 5
TOP: Heavy oil pumps
BOTTOM: A conventional oil rig

The Resources



Conventional Crude Oil

The first hint of the province's crude oil wealth appeared in 1870, when a geological survey discovered traces of both oil and gas in the southwestern part of what was to be called Alberta. In 1886, an Alberta homesteader, John George "Kootenai" Brown, dipped gunny sacks in an oil seepage in a creek in the area that later became Waterton Lakes National Park. The sacks soaked up the oil, which he sold to nearby ranchers as a lubricant and lamp fuel. In 1902, the first producing oil well in Western Canada was successfully completed at a site called "Oil City" near Brown's homestead, but production dwindled by 1904. This brought an end to the grand hopes for Oil City.



The 1914 discovery of oil at Turner Valley, southwest of Calgary, touched off Western Canada's first oil boom. The excitement proved short-lived, however, because volumes were small and the oil was in the form of light hydrocarbon, called condensate. Turner Valley was not recognized as a significant field until 1936 when deeper drilling revealed crude oil at a depth of 2,524 metres (8,281 feet).

The modern age of the petroleum industry began in 1947 with Leduc No. 1, just south of Edmonton, where oil was discovered at a depth of 1,550 metres (5,085 feet). The find, after years of fruitless exploration, spawned intensive exploration and growth in Alberta's petroleum industry over the next two decades. Additional major reserves were discovered near Redwater and Swan Hills, and, more recently, in the West Pembina, Rainbow Lake and Central Foothills regions.

Finding conventional oil reserves can be difficult and expensive. Although more than 5,000 oil pools have been discovered in the province to date, about half of Alberta's conventional oil production comes from just 25 major pools. In the future, conventional oil production will decline in relative importance, while natural gas, oil sands and coal will be increasingly prominent.

About 45 per cent of Alberta's crude oil production is used for transportation fuels. It is turned into gasoline for cars, diesel fuel for trucks and locomotives, jet fuel for aircraft and heavy fuel oil for ships. Another 45 per cent provides heating fuel for homes and offices. The remaining 10 per cent is used for lubricants, asphalts and petrochemicals.

Enhanced Oil Recovery

Three methods can be used to recover oil from a reservoir. In some cases, more than one recovery method may be required.

1. Primary recovery: Relies on natural reservoir pressure, usually assisted by pumps, to lift oil to the surface.
2. Secondary recovery: Increases reservoir pressure by injecting water into the reservoir. The increased pressure will improve the oil flow into the producing wells.
3. Tertiary recovery: Uses advanced engineering technology to recover additional reserves of oil from a reservoir. This is generally referred to as Enhanced Oil Recovery (EOR).

The reduction in Alberta's conventional oil reserves is spurring efforts to improve production from existing fields through EOR techniques. Using primary and secondary recovery methods, only about one-third of the oil in a reservoir can be recovered. An additional 10 to 25 per cent of the oil can be obtained through EOR methods.

Most true EOR schemes in Alberta employ the miscible flood method, which involves injecting natural gas liquids (mainly ethane, liquefied under high pressure and low temperature) into a reservoir. These liquids mix with oil in the small pore spaces in the rock, flushing out some of the remaining oil.

The Government of Alberta encourages the use of EOR methods through special programs. To date, 48 EOR projects have been approved and 20 more are planned by 1992.

The development of EOR technology was added to the mandate of the Alberta Oil Sands Research and Technology Authority (AOSTRA) in 1980. (See Page 8.)

Crude oil does not pass directly from the oil well to the consumer, but goes through an intermediate stage, called refining. Individual refineries sometimes differ according to the type of crude feedstock (oil from the well) available to each, but most employ various techniques to manufacture petroleum products from refined crude. The technique of cracking, for example, involves breaking down heavier, more complex hydrocarbon molecules into simpler, lighter molecules.

Heavy Oil

Alberta's production of heavy oil started in 1914, from a pool southeast of Wainwright. Production in quantity began in 1926 in that area. The first well in the Lloydminster area, from another pool, began commercial production in 1944.

This oil, refined in a small local facility, was used by railroads as bunker fuel. By 1955, however, the demand for bunker-type fuel oil was almost non-existent. Today, heavy oil is used mainly for highway paving, shingles and roofing tar. The U.S. midwest is the largest market for this oil.

Remaining established reserves of conventional heavy oil in Alberta contain an estimated 47 million cubic metres (300 million barrels). Only a small percentage, however, is recoverable by primary methods. Today, the same thermal recovery methods which are being used in the oil sands are also improving the outlook for heavy oil recovery.

In the future, facilities may be developed in Alberta which would upgrade heavy crude into lighter conventional oil for refining.

PHOTO: Some of Alberta's crude oil production is used for transportation fuels

Oil Sands

Long before Alberta became a province, Indians in northeastern Alberta used heavy black tar from the banks of the Athabasca to seal seams in their canoes. They were the first users of Alberta's oil sands, a black, sticky mixture of sand, clay, water and bitumen.

The oil sands are partially exposed along the banks of the Athabasca River, north and south of Fort McMurray in northeastern Alberta, and were noted in the journals of Peter Pond, Alexander Mackenzie and David Thompson in the 1700s. Emulating the Cree Indians of the region, the explorers mixed the bitumen with resin from spruce trees to seal their canoes. Earlier this century, some Edmonton streets were paved with oil sands.

Geological investigations began in the Fort McMurray region in the late 1800s. The first geologists theorized that the sands had become saturated with oil that seeped from huge oil pools beneath the ground. Although drilling persisted until the 1920s, core analyses eventually showed that no such pools existed.

Today, major deposits have been confirmed in four geographic areas: Athabasca, Cold Lake, Peace River and Wabasca. Together, these deposits underlie more than 60,000 square kilometres (23,000 square miles) of northern Alberta. The Athabasca deposit at Fort McMurray is the largest single hydrocarbon accumulation

Gigantic Syncrude

Syncrude, the single largest oil sands mining operation in the world, represented a monumental construction challenge. The $2.3-billion cost made Syncrude one of the biggest projects ever completed in Canada.

Up to 10,000 people worked a total of 48 million hours over five years to build the plant. Draglines, which are giant excavators with booms 110 metres (362 feet) long and 90-cubic-metre buckets (3,214 cubic feet), move and pile 93 million tonnes (103 million tons) of oil sand per year. When all four draglines are operating, they use enough electricity to power a city of 150,000 people.

The oil sand is placed on conveyor belts and moved into the extraction plant, where steam and hot water are used to separate bitumen from the sand. Over 90 per cent of the bitumen is recovered from the sand.

Syncrude today supplies over 10 per cent of Canada's oil production. Market spin-offs from Syncrude include engineering equipment, electronics, pumps, conveyor belting and cold-weather technology.

LEFT: Dragline at the Syncrude oil sands mine
RIGHT: Syncrude plant

in Alberta. Ten per cent of the bitumen in this deposit is close enough to the surface to be mined; the rest of the deposits must be recovered using other methods.

In the 1920s, hot water separation techniques to recover bitumen were developed by Dr. Karl Clark of the Alberta Research Council. In the 1930s and 1940s, private, federal and provincial agencies launched experimental plants to mine the oil sands lying closest to the surface and extract the bitumen by water flotation processes.

Synthetic crude oil is the term used to describe crude oil produced by upgrading bitumen. The pioneer in this kind of oil production, Great Canadian Oil Sands Ltd. (now Suncor), opened its plant near Fort McMurray in 1967. In 1978, Syncrude Canada, a consortium of corporate and government investors, also began large-scale operations. At both plants, oil sand is actually removed, or mined, from the ground and the bitumen is then extracted. Bitumen is subsequently upgraded into synthetic crude and the mined-out land is reclaimed.

Mining projects only scratch the surface of the oil sands. Another basic recovery method, called *in situ* (Latin for 'in place'), can be employed to recover deposits that are too deep to mine. Such projects employ special techniques to make the bitumen flow from the sand while it is still in the ground. This thick substance is then pumped to the surface for processing.

Esso's Cold Lake project and the BP/Petro-Canada Wolf Lake project illustrate the use of in situ techniques. At Cold Lake, oil sand deposits are buried more than a kilometre beneath the surface. Bitumen is recovered by drilling wells into these deposits, and injecting steam to heat the oil until it is fluid enough to be pumped to the surface. The oil sand is left in place. Today, numerous companies recover bitumen from deeper deposits with assorted recovery techniques. (Some, for example, employ fire instead of steam to heat bitumen.)

Alberta is the world's major supplier of petroleum products from oil sands. Some synthetic crude oil from oil sands plants in the Fort McMurray region is processed in refineries around Edmonton; the remainder is shipped to refineries from Montreal to Vancouver. The synthetic crude is processed into fuel products, including gasoline, jet and diesel fuel, fuel gases (butane or propane) and naphtha products such as pesticides, adhesives and polishes.

Headquartered in Edmonton, the **Alberta Oil Sands Technology and Research Authority** pursues new technology for oil sands and heavy oil recovery and enhanced techniques for conventional crude oil recovery. AOSTRA's mandate is to provide the private sector and research organizations with financial incentives to develop petroleum technology in these areas. It also promotes education and training in oil sands development by funding scholarships, fellowships and professorships.

Improved upgrading of bitumen is one of AOSTRA's major objectives. When bitumen and heavy oils are upgraded, the yield of light oil products from refining increases. Researchers are studying the molecular structure of bitumen, looking for upgrading processes that will be superior to the thermal cracking and hydrogen addition processes now employed.

AOSTRA has also developed systems for collecting, storing and retrieving information published on the oil sands. As well, technology exchange agreements have been signed with many foreign organizations.

The technology to commercially produce synthetic crude oil from bitumen is itself a new and uniquely

Canadian industry. Eventually this technology may permit production of enough synthetic crude oil to replace declining conventional crude oil production.

Producing high-quality synthetic crude from bitumen is one way of adding value to Alberta's raw energy resources. Such value-added processes create employment and ensure that Albertans derive maximum benefit from their own resources. Upgrading is of increasing importance in Alberta's quest for a more stable, diversified economy.

Pilot Project Tests Horizontal Wells

Studies of reservoir performance in Alberta suggest that in some cases — where geology is favorable — horizontal wells may provide better drainage than vertical wells.

An innovative pilot program is being undertaken by AOSTRA to test this possibility. The Underground Test Facility, located about 45 kilometres (28 miles) northwest of Fort McMurray, was built after nine years studying and testing the economic feasibility of horizontal wells.

AOSTRA believes that steam, injected into closely spaced horizontal wells, may provide the heat necessary to mobilize the oil. This idea is being tested through a system of shafts and tunnels that provide underground access to the oil sands formation. Parallel wells drilled from the tunnels beneath the oil sands allow for heating of the reservoir, and for gravity to assist in draining the heated bitumen. The bitumen then flows to a central underground storage location for pumping to the surface. Researchers report excellent results to date and are exploring commercial potential.

This pilot program is one of many in major oil sands deposits in Alberta. Research is essential because no single method of in situ technology can be successfully applied to all oil sands deposits. Each deposit is different. Even within the same deposit, the thickness of oil sands can vary, as can the composition of the formation in which it is found.

While Alberta has already met the challenge of developing its enormous oil sands, future research holds even more promise for increasing recovery rates and lowering costs.

Natural Gas

Natural gas is a mixture of hydrocarbons, predominantly methane, that exists in a gaseous state.

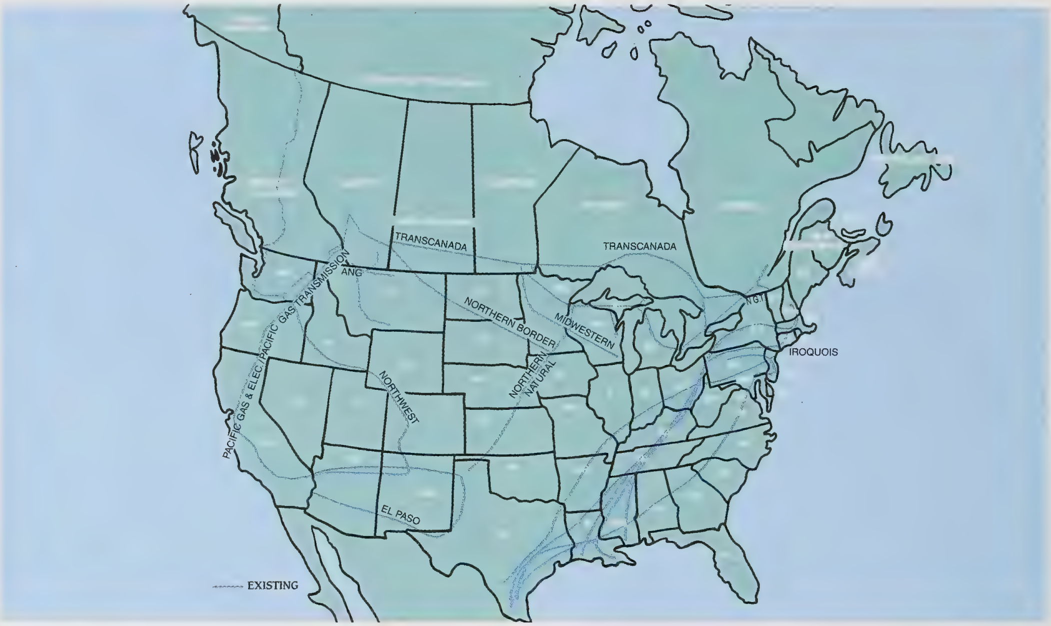
Alberta's abundant supplies of natural gas have not always been considered valuable. When CP Railway employees struck natural gas while drilling for water west of Medicine Hat in 1883, they packed up and left in disgust. Other gas strikes were also ignored until 1890, when a gas well was developed to supply the street lights of Medicine Hat. Gas was not used commerically to any extent in Alberta until after 1900, because the large distance between well sites and potential users presented a major problem.

In 1906, Archibald Dingman built a pipeline to transport and distribute natural gas to one area of Calgary. The Prairie Gas Fuel Company was formed in 1910 to produce natural gas from Bow Island and deliver it to the city. The twcompanies merged into the Canadian Western Natural Gas Company in 1911, which grew to be a major utility. By the 1920s, natural gas was being successfully marketed as a residential fuel in Edmonton and Calgary.

The earliest processing of natural gas liquids simply separated hydrogen sulphide and liquid hydrocarbons (condensate) from the gas stream. First built in 1933, three Turner Valley plants formed the only gas processing industry west of Ontario for over 20 years. Following the major oil discovery at Leduc in 1947, substantial gas discoveries at Pincher Creek, Jumpingpound and Cessford established the province as a leading supplier of natural gas and attracted a vital petrochemical industry which uses natural gas as its source material.

Page 8
TOP LEFT: Oil sands conveyor belt
BOTTOM: Oil sands bucketwheel excavator
Page 9
TOP RIGHT: Gas plant in the Alberta foothills

Major Gas Pipelines of North America



Today, the province has more than 400 processing plants and more than 18,000 known gas reservoirs. Albertans make effective use of natural gas, relying on this resource rather than oil or coal for heating. Alberta has always had the potential to produce more natural gas than it requires, and therefore exports almost 70 per cent of its marketable natural gas to other provinces and the United States.

Alberta's natural gas provides methane for use as a heating fuel, natural gas liquids such as propane and butanes for industrial and domestic use, and substantial amounts of ethane, for use in the production of ethylene-based petrochemicals and in enhanced oil recovery (see page 6). Natural gas is also used for the generation of electricity.

Natural gas components are separated and liquefied through processing methods which remove hydrogen sulphide and other impurities. Liquefied gases occupy only 1/600 as much space, and can be conveniently transported and stored. Elemental sulphur, recovered as a co-product of gas, is another valuable resource for Alberta, used heavily in the agricultural fertilizer industry. (See Page 13.)

Alberta's substantial supplies of competitively priced oil and gas have led to major petrochemical developments during the 1970s and the early 1980s. Today, the province's petrochemical industry has assumed a leadership position in Canada.

The industry can basically be separated into two divisions: the primary industry produces basic chemicals, such as ethylene, styrene and methanol, from oil and gas; the secondary industries convert basic petrochemicals into feedstocks for use by plastic industries. Ethylene, one of the most versatile petrochemicals, is used as a building block in the manufacture of plastics, anti-freeze, adhesives, paints, textiles and many other items. Plastics manufacturers within Alberta produce consumer items ranging from plastic containers and coffee cups to garbage bags.

Major chemical and fertilizer companies that now have plants in Alberta include Alberta Gas Chemicals, Dow Chemical, Celanese, CIL, Esso Chemical Canada, Union Carbide, Shell Chemical Canada, Sherritt Gordon and Novacor Chemical. The province's refining base includes two world-scale ethane cracking plants at Joffre, which produce ethylene.

Alberta's petrochemical industry produces more fertilizers, mostly of the nitrogen-type, than any other province. Between 40 to 60 per cent of the fertilizers produced in the province are consumed in Western Canada, with the balance exported.

Page 11
PHOTO: Coal Research Centre, Devon

Coal

Coal mining in Alberta had its origins in the late 1700s when Peter Fidler, a Hudson's Bay Company explorer, sighted coal along Rosebud Creek near Drumheller in southern Alberta. In north-central Alberta, it was used in the Fort Edmonton region as early as the 1840s.

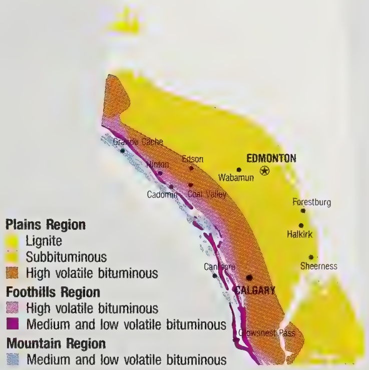
The first recorded coal mine started in 1874 on the banks of the Oldman River downstream from Lethbridge. It was followed during the 1880s by the opening of mines in the Canmore, Medicine Hat and Edmonton areas. Mines at first employed underground room-and-pillar methods, but strip mining became more popular in the plains area after 1910.

Alberta's Three Coal Regions

Alberta's coal reserves are distributed over three distinct areas — the mountains, the foothills and the plains. Alberta coals range in rank from subbituminous coals mined in the plains to high volatile bituminous thermal coal in the foothills and low and medium volatile bituminous coking coal mined in the mountains. Minor deposits of semi-anthracite coal exist in the Canmore area.

The major market for Alberta thermal coal is for the generation of electricity within the province, as well as in Ontario and the Far East. Coking coal is used for steel production in the Far East, Latin America, Europe and eastern North America.

Alberta's Coal Resources – Ranks and Regions



By the mid-1920s, coal had emerged as a major Alberta industry, providing fuel for domestic heating and steam locomotives. Coal enjoyed widespread use until the early 1950s, when it was almost entirely replaced by oil and gas for domestic heating, industrial purposes and transportation.

Interest in coal was revived in 1962 when the first coal-fired electric power plant began operating at Wabamun. In 1967, the negotiation of a contract with Japan for 26 million tonnes (29 millon tons) of coking coal revived the industry. In recent years the domestic market has broadened as other coal-fired electric power plants have come into service.

Today, Alberta supplies 44 per cent of Canada's coal. Seventy per cent of Alberta's coal is used for power production in the province; 24 per cent is exported and the remainder is sold elsewhere in Canada.

In 1984, the **Office of Coal Research and Technology** was established to assist the industry. Based in Edmonton, the Office provides funding for coal technology development and is administered and managed by the Alberta Department of Energy. Its broad aims include improving the competitiveness of Alberta coals in international markets, assessing the environmental impact of mining and coal use, and finding new uses for Alberta coals. Research work focuses on subjects ranging from coal exploration and mining to coal transportation.

The **Devon Coal Research Centre** was built with funds from the **Alberta/Canada Energy Resources Research Fund** (A/CERRF), also administered by the Alberta Department of Energy. The centre employs 120 staff members and houses several coal research groups, including an arm of the **Alberta Research Council**. Funding for some research groups in Devon is provided by the Office of Coal Research and Technology.

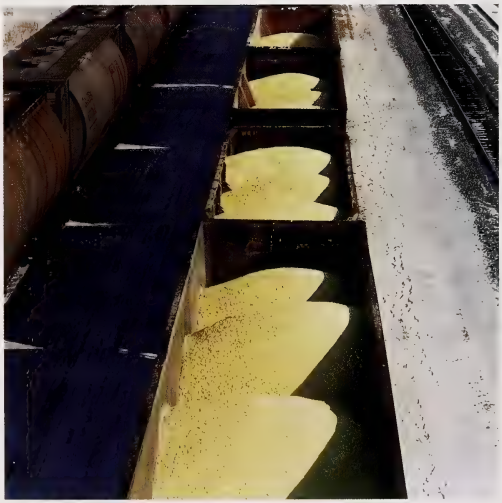
Minerals

Alberta's mineral resources are divided into two distinct categories. ''Industrial'' or non-metallic minerals, such as limestone, shales and sodium sulphates, are used in the province's construction and chemical industries. With the exception of sulphur, most production is consumed within Alberta.

Metallic minerals, such as silver, gold and uranium, have not been found in significant amounts in Alberta. The province has no operating metal mines, although there is a small amount of placer gold produced. Alberta's other metallic metals include silver, copper, lead, zinc, magnetite, titanium, vanadium and nickel.

Situated between two mineral-rich regions of Western Canada, the geological terrain of Alberta has four distinct parts, each with specific geological potential. The Precambrian Shield of northeastern Alberta consists mainly of granite, gneiss and various types of schist. Most of Alberta lies within the Interior Plains, underlain by sedimentary strata of variable composition and origin. The Foothills are generally composed of sandstone and shale. The Rocky Mountains are made up mostly of carbonite and quartzite formations, vast reserves of limestone and dolomite and scattered showings of industrial and metallic minerals.

Potential exists for significant finds, as the province has been poorly explored for metallic minerals compared with most other provinces and territories in Canada.



A sulphur train

MINERAL PHOTOS:
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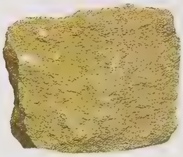
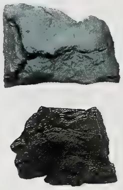
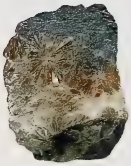
Industrial Minerals



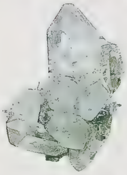
Limestone is found in huge reserves along many of the ranges of the Rocky Mountains, with the best deposits located along the Eastern Slopes. The two largest quarries, at Cadomin and Exshaw, produce limestone for cement-making. Lime is produced in Alberta from quarries in the Crowsnest Pass and the Bow Valley. Chemical and metallurgical industries are the major users.



Clays and Shales are widespread in Alberta. The clays are mostly low grade, suitable only for cement or low-value ceramic use. Some intermediate grades, such as stoneware clay, are found in a few localities. They are useful for higher-value products such as facing brick, pottery and stoneware crocks.



Gypsum occurs in Alberta, but is undeveloped because of its inaccessibility. Areas with the best development potential are found in northeastern Alberta.

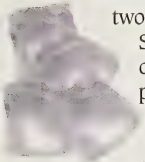


Silica sand is produced from local sand dunes near Bruderheim, northeast of Edmonton. Silica is sold as fibreglass and sandblasting material, and also finds commercial application as railway traction sand, in filtration and in fracturing techniques used by the oil and gas industry.

Dimension stone: Sandstone is taken in small volumes from quarries near Canmore in the Rocky Mountains. Local stone has been employed for various building and ornamental purposes for many years. The Alberta Legislature and other government buildings in Edmonton are built from the local Paskapoo sandstone. Granite in the northern Alberta region of Fort Chipewyan has commercial potential.

Construction aggregates constitute by far the largest volume of industrial mineral production in Alberta. The province has rich resources of sand and gravel distributed throughout the province.

Phosphate is known to occur in west-central Alberta. Commercial extraction has not started as recovery techniques have yet to be tested.



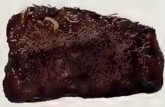
Salt is found in huge deposits underlying almost half the province. Today there are two operating salt plants: one at Fort Saskatchewan and one at Lindberg, east of Edmonton. The wood pulp industry provides a major market for Alberta salt. Part of the province's salt production is used in a non-refined state, for purposes ranging from household consumption to ice control on roads.

Sodium sulphate is produced from a single plant at Metiskow Lake, east of Red Deer. Alberta's sodium sulphate is a high-purity product used mainly in detergents.

Sulphur, mostly extracted as a co-product of natural gas processing, is an important resource for Alberta. More than 50 per cent of Alberta's natural gas contains at least one per cent hydrogen sulphide. The hydrogen sulphide is removed before natural gas enters a pipeline, and is then converted to elemental sulphur.

Sulphur is primarily used domestically by the wood pulp processing industry for the manufacture of bleaching liquor, and in the fertilizer industry. The province is a major world producer and exporter, with much of its production exported to the large agricultural market in the western United States, as well as to Western Europe, Africa and New Zealand.

Other Minerals

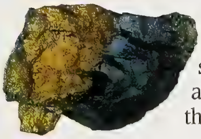


Peat bogs are widespread throughout the northern two-thirds of the province. Peat is commercially harvested in four localities, mostly for use in gardens. The largest plant is near Evansburg.

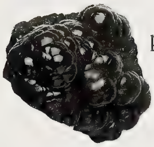
Metallic Minerals

During the late 1800s and early 1900s, a few small copper or copper-silver mines operated in the Rocky Mountains in the southwestern part of the province. The first mining town, Silver City, was established in 1881, 30 kilometres (19 miles) west of Banff, after the discovery of copper and silver. A large number of claims were staked in the vicinity and three mines were started near the town. No economically viable deposits were found, so the town was torn down between 1886 and 1888. Some mining claims were held by companies until the 1970s.

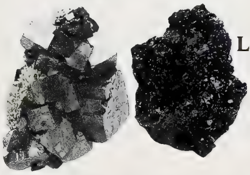
The old workings were rejuvenated during the First World War, and several copper mines operated until the early 1920s within the boundaries of Banff National Park. Exploration for copper continued until the late 1960s in an area north of Waterton Lakes National Park, and minor exploration for lead/zinc mineralization was carried out in an area north of Crowsnest Pass. Today, potential for the discovery of major metallic minerals production exists mainly in the Precambrian Shield of northeastern Alberta, and in Paleozoic limestone of northern Alberta.



Copper showings occur locally in the Rocky Mountains in southwestern Alberta. The grades and thicknesses are currently thought to be uneconomical.



Iron ore deposits of considerable potential are found in the Clear Hills area of northwestern Alberta. There is no development because of the low grade and complex metallurgy of the ore.



Lead-Zinc is found in scattered showings in the Rocky Mountains and Plains regions of Alberta.

Some Trace Minerals

Nickel *(top)*, **Titanium, Vanadium and Zirconium** *(bottom)* occur in trace amounts in the Athabasca oil sands, and are potentially recoverable as by-products of oil sand processing.

Placer gold is found in small amounts in a widespread area of Alberta. There is a small commercial production from gravel-screening operations in the Edmonton and Red Deer areas. Showings of lode gold have been reported in the Fort McMurray region.

MINERAL PHOTOS:
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Alberta's Energy Milestones

1872 Nicholas Sheran opens Alberta's first coal mine on the banks of the Oldman River near Lethbridge.

1883 A well drilled at Alderson to supply water to the CP Railway strikes gas instead.

1896 First hydroelectric power plant opens at Calgary (Eau Claire plant).

1912 Natural gas transmission line, 270 kilometres (168 miles) long, from Bow Island to Calgary, completed in record 86 days.

1914 Dingman No. 1, in Turner Valley, Calgary Petroleum Product's first well, strikes oil and begins an investment spree which sees over 500 companies formed within a few months.

1925 First oil pipeline from the Turner Valley to Imperial Oil's refinery in Calgary is built.

1930 First oil sands recovery operations attempted in the Fort McMurray area by International Bitumen Company at Bitumont and McMurray Bitumen and Oil Company at Draper.

Administration of resources (excepting those in federal parks and Indian reservations) transferred from the Dominion Lands Office to the Province of Alberta.

1932 The Oil and Gas Conservation Act, Province of Alberta, passed.

1933 First natural gas processing plant in Western Canada built by Royalite Oil Company at Turner Valley.

1938 The Petroleum and Natural Gas Conservation Board (later named the Energy Resources Conservation Board) established.

1940 Abasands Oil Ltd. starts small-scale commercial oil sands plant near Fort McMurray using hot water separation process.

1947 Imperial Oil brings in Leduc No. 1 well, opening a new era in the Canadian petroleum industry.

1950 A crude oil pipeline to export crude from the Redwater field is built by Interprovincial Pipe Lines from Edmonton to Superior, Wisconsin.

1954 The first hydrodesulphurization unit in Canada is installed at the heavy oil refinery in Lloydminster.

1957 Interprovincial's oil pipeline is extended to Toronto. At 3,105 kilometres (1,929 miles), it is the longest pipeline in the world.

First thermal coal-fired electric generating plant at Wabamun, operated by Calgary Power, begins operations.

1963 Alberta emerges as a world-scale sulphur producer. More than 1.2 million tonnes (1.3 tons) are produced as a byproduct of the natural gas processing industry.

1964 Pacific Petroleum's first phase of the largest natural gas processing plant of its kind in the world opens near Empress to process all gas transmitted eastward via the TransCanada pipeline.

1967 Alberta Resources Railway completed. It is designed to ship coking coal from Smoky River near Hinton.

Great Canadian Oil Sands (now Suncor) begins producing synthetic crude oil from its commercial plant at Fort McMurray.

1978 Syncrude, the second commercial-scale oil sands plant in Alberta, starts operations at Fort McMurray.

Luscar Sterco's huge surface coal mine at Coal Valley begins operations to supply Ontario Hydro with 1.8 million tonnes (2.0 million tons) of high-quality thermal coal. The company uses an innovative computerized unit train coal loading and hauling system.

1980 Petroleum and natural gas rights bonuses top the $1 billion mark for the first time, indicating an all-time high for petroleum exploration and development in Alberta.

1983 After almost two decades of research, Esso Resources begins construction of a commercial production project at Cold Lake, using in situ oil sands recovery technology. The project is being developed in several stages, with total investment at $1 billion by July 1987.

1985 A federal-provincial agreement, the Western Energy Accord, is signed. It removed controls on the pricing and marketing of crude oil and petroleum products, and laid the foundation for the deregulation of domestic gas markets.

Glossary of Terms

Bitumen — A naturally occurring viscous mixture of hydrocarbons that in its natural state is not commercially recoverable through a well. It is composed mainly of carbon, and lesser amounts of hydrogen and sulphur; the rest consists of oxygen, nitrogen and various impurities.

Butane — One of the most useful of petroleum gases, butane can be liquefied under pressure and conveniently stored, or distributed for cooking and domestic heating. When blended into gasoline it improves volatility and octane number.

Condensate — A mixture of pentanes and heavier hydrocarbons that is recovered or recoverable from a reservoir. Condensates are in a gaseous state in the reservoir but emerge from the well as liquid.

Conventional Crude Oil — Oil that can be recovered through a well at a commercial rate.

Cracking — The process of breaking down the larger, heavier and more complex hydrocarbon molecules into simpler, lighter molecules. Separating crude oil or bitumen into fractions.

Crude oil — The raw material of petroleum which must be refined to produce fuels and other products. All crude oil is not the same — crude oils from different locations vary considerably in viscosity, specific gravity and purity.

Established Reserves — The total amount of oil in reservoirs which is thought to be recoverable using known technology and under current economic conditions.

Feedstock — Basic materials for a refining or manufacturing process, usually crude oil or natural gas.

Hydrocarbons — Organic chemical compounds of hydrogen and carbon atoms which form the basis of all petroleum products.

In situ — In place.

Life Index — The ratio of proved remaining established reserves to annual production levels.

LNG (Liquefied Natural Gas) — Gaseous hydrocarbons (mainly butanes and propane) that have been liquefied at moderate pressures. As liquids, these hydrocarbons can be conveniently transported to industrial or domestic users.

Marketable Natural Gas — Natural gas which meets specifications for use as a domestic, commercial or industrial fuel, or as an industrial raw material.

Natural Gas — Gaseous forms of petroleum found in subsurface rock formations, consisting of methane (80 to 95 per cent) and other gases.

Oil Sands — Sand and other rock materials which contain crude bitumen.

Petrochemicals — Chemicals made from crude oil and natural gas.

Petroleum — From the Latin *petra* — rock — and *oleum* — oil, rock oil, indicating that it is found in the earth's crust. Petroleum is a complex mixture of hydrocarbons. Components may vary greatly from region to region, but generally it has a carbon content of 83-87 per cent, a hydrogen content of 11-14 per cent, minor amounts of oxygen, nitrogen and sulphur, and traces of metals.

Propane — A petroleum gas often used as a heating and cooking fuel. Readily liquefied under pressure, it is a convenient and transportable fuel.

Reservoir — A porous, permeable sedimentary rock structure or trap containing oil and/or natural gas. A reservoir can contain more than one pool (an accumulation of oil or gas).

Synthetic Crude Oil — Crude oil produced by upgrading bitumen.

Thermal Electricity — Electricity produced at electrical-generating plants using coal, natural gas or oil as fuel, as compared with hydroelectricity which is produced using water or steam power.

Appendix

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